NORTH CAROLINA STATE UNIVERSITY
Department of Chemistry Name_____

CH 331 Homework 5
Physical Chemistry I September 27, 2004
Due Date: Oct. 4 2004

Show some work/reasoning for each answer. No explanation = no credit.

Calculate a two-component composition/ pressure phase diagram for methanol and ethanol at 300 K. The enthalpy of vaporization of methanol is $\Delta_{vap}H^o$ = 35.3 kJ/mol and the enthalpy of vaporization of ethanol is $\Delta_{vap}H^o$ = 43.5 kJ/mol. The boiling points of methanol and ethanol are 337.2 K and 352 K, respectively. Assuming component 1 is ethanol and component 2 is methanol,

a. Calculate the vapor pressure of each liquid at 300 K.
b. Calculate the total vapor pressure of a methanol/ethanol mixture at $x_2 = x_{methanol}$ = 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0.
c. Calculate the total vapor pressure of a methanol/ethanol mixture at $y_2 = y_{methanol}$ = 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0.
d. Draw the two-component composition ($z_{methanol}$)/pressure diagram. Label the number of phases (p) and degrees of freedom (f) from the Gibbs phase rule in each region of the diagram.
e. For z_2 = 0.5 calculate the vapor pressure above the solution when it begins to boil.
f. For z_2 = 0.5 calculate the vapor pressure above the solution when the last drop of solution is vaporized.
g. Using the lever rule determine the composition and the relative amount of both liquid and vapor when the vapor pressure is the average of the vapor pressure in parts e. and f.. In other words determine x_2, y_2, and n^{liquid}/n^{vapor} when the vapor pressure is halfway between the pressure in parts e. and f.